The CORNELL ENGINEER

In This Issue:

GERMAN TECHNICAL EDUCATION

By John Hedberg, C.E., '29

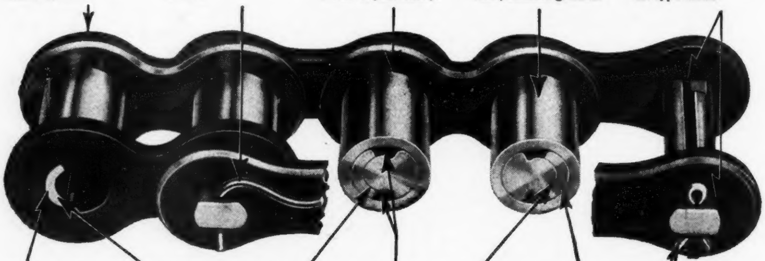
Volume 2 FEBRUARY, 1937 Number 5

SUPERIOR FEATURES FOUND ONLY IN

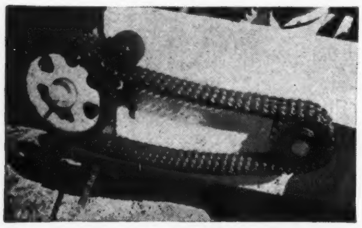
MORSE ROLLER CHAIN

"An outstanding achievement—the first real advance in roller chain construction in many years." That was the comment of a prominent engineer when he saw the new Morse Roller Chains several years ago. Since that time, Morse Roller Chains have demonstrated in thousands of applications that they are better—a really modern chain.

NOTE MANY EXCLUSIVE MORSE ROLLER CHAIN FEATURES

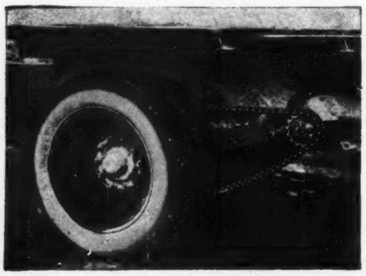


POSITIVE LUBRICATION · RELIABILITY
LONG LIFE · LOW COST · ECONOMICAL



In Asphalt Plant

Here is a Morse Roller Chain drive that does plenty of work. A 40 H.P. drive connecting two jackshafts, used to rotate a cylinder in an asphalt plant. The drive is only covered with grease from time to time—does not operate in bath of oil, and is subject to severe shocks as the machine is loaded with various size gravel and tar. Plant owners are well satisfied with the superior performance of Morse Roller Chains.



For Truck Service

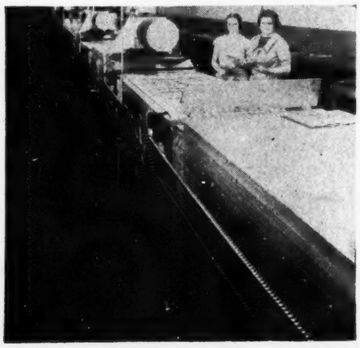
Truck service puts any roller chain on the spot. Morse Roller Chains are being specified more and more for this tough service by truck manufacturers and truck users. Long retention of lubrication, a feature of these chains, makes for longer wear.

Morse Spring Lock Cotter

The twist in the pin exerts powerful holding influence against loss of cotters due to vibration and chain whip—effectively guards against loss of side plates and chain breakage. Morse spring lock pins are recommended in place of cotter pins. They will not shake loose, and do not come out, but are easily removed.

Morse Roller Chains, Cadmium plated, are now available for use on installations where resistance to salt spray and chemicals is necessary.

Standard attachments can be fitted to either side or both sides of Morse Roller Chains for use as conveyors



Typical installation of Morse Roller Chains on a mirror manufacturing machine.

Morse Roller Chains are available in all standard sizes. Morse engineers and representatives are located in the principal cities throughout the country. Complete engineering bulletins will be mailed to you on request. Write Morse Chain Company, Ithaca, New York.

MORSE CHAIN COMPANY, ITHACA, N. Y.

DIVISION OF BORG-WARNER CORPORATION

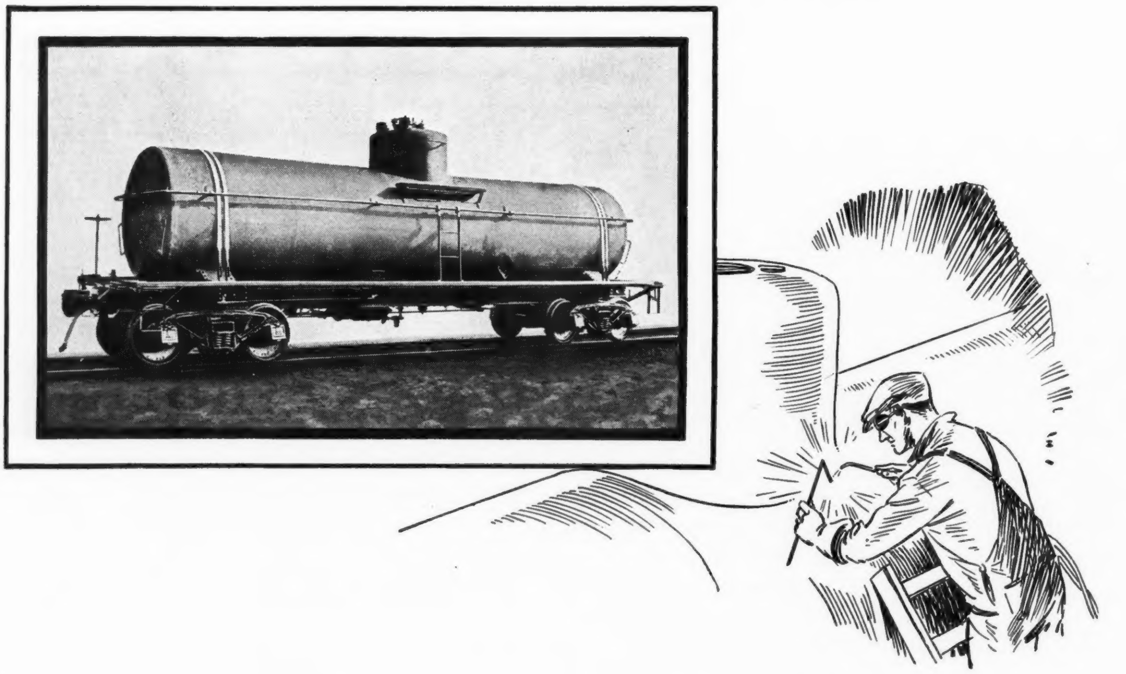
Better . . because IT'S WELDED

Welding eliminates overlapping joints in the modern tank car. This materially reduces dead weight and makes the car easier to clean and maintain. It completely prevents loss or contamination of the contents from rusted joints.

Tomorrow's engineers will be expected to know how to apply the oxy-acetylene process of welding and cutting in design, construction and fabrication to give similar sales advantages to many good products.

The word "welded" is packed with meaning. It means light-weight without sacrifice of strength. It means sturdiness and ruggedness that can never shake loose. It means invisible joints as strong as the base metal. It means smooth surfaces with no place for corrosion to start. In short it means all that one piece construction can mean plus complete design freedom from the limitations of other methods of fabrication.

Technical booklets describing the application of this modern metal-working process to a wide range of metals—steel and iron, aluminum, copper, brass and many other alloys and metals are available, without obligation, from any Linde Office. Write to The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, New York and principal cities.



Everything for Oxy-Acetylene Welding and Cutting

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES FROM PRODUCTS OF UNITS OF UCC UNION CARBIDE AND CARBON CORPORATION LINDE UNION CARBIDE

THE CORNELL ENGINEER

PUBLISHED MONTHLY DURING THE COLLEGE YEAR

Volume 2 **FEBRUARY, 1937** **Number 5**

COMMENTS

Sailing is viewed from a comparatively new angle in Mr. O'Connor's "The Aerodynamics of Sails". He shows the effects of wind on the sails of racing yachts, and discusses scientific analysis as now being used for the design of rigging.

* * *

In his article concerning "German Technical Education," Dr. Hedberg prophesys a dark future for the engineering and related fields in that country, and explains the probable effect of the present military program on engineering students.

* * *

The student-written article in this issue, "Steel—A Modern Industrial Giant", by A. H. Sullivan, E.E. '38, is a photomontage in words. It will be of particular interest to those undergraduates who have not studied the manufacture of steel.

CONTENTS

MEMBERS OF THE ENGINEERING COLLEGE MAGAZINES ASSOCIATED

Chairman: Prof. Richard W. Beckman
Iowa State College, Ames, Iowa

Arkansas Engineer
Colorado Engineer
Cornell Engineer
Illinois Technograph
Iowa Engineer
Iowa Transit
Kansas Engineer
Kansas State Engineer
Marquette Engineer
Michigan Technic
Minnesota Techno-Log
Nebraska Blue Print
New York Univ. Quadrangle
North Dakota State Engineer
Ohio State Engineer
Oregon State Technical Record
Penn State Engineer
Pennsylvania Triangle
Purdue Engineer
Rose Technic
Tech Engineering News
Villanova Engineer
Washington State Engineer
Wisconsin Engineer

Published monthly during the college year, October to May. Subscription prices for Alumni through the Cornell Society of Engineers—$2.00, by Post Office Money Order, Check, etc., to the Cornell Society of Engineers, 245 Madison Avenue, New York, N. Y. This subscription includes membership in the Cornell Society of Engineers. Subscriptions not including membership in the Cornell Society of Engineers $1.50. Price of this issue $.15. Entered as second class matter at the Post Office at Ithaca, N. Y. Acceptance for mailing at special rate postage provided for in Section 1103, Act of October 3, 1917, authorized August 1, 1918.

Courtesy Bethlehem Steel Co.

Steel Industry

The CORNELL ENGINEER

Volume II | February, 1937 | No. 5

The Aerodynamics of Sails

By W. C. O'Connor, A.E. '35

Photos Courtesy of "Yachting"

A 26-Foot Gaff-rigged Sloop

Only during the last few years have the yachtsmen of this country taken any considerable interest in the theoretical side of yacht designing and in the laws governing the wind pressure which drives their yachts. Previously they were content to master the practical side of sailing and leave the theory to the naval architect and the sailmaker. Considerable development of hull form resulted from tank experiments, but few experiments of a radical nature were made on the sails prior to the advent of the airplane. With the airplane came the study of aerodynamics, displacing the guess work which had been the main guide up to this time. The step forward came when the Marconi rig made its appearance. At this time the yacht sailor became aware of the advantages to be gained through a better understanding of the physical laws governing the effect of wind on his sails. The result, which has already gained recognition, is that, in the future, the greatest development in yacht design will be in sails and rigs and in the elimination of air resistance through a better appreciation of the forces involved.

It is not the author's intention to explain all the experiments which have been performed, but to give the most important in detail, and merely to summarize the results of the others. First, a ship sails not by means of the pressure, which arises from the impact of

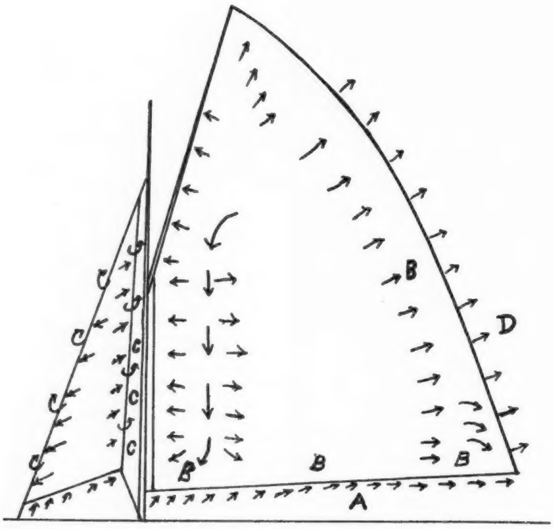


Diagram No. 1
Direction Of Air Currents

the wind on the sail, but chiefly by means of the "suck," on the leeward side of it. This is very easy to prove in the following simple manner. First, build a tin model of a sail and cut holes into it just high enough to receive the instrument with which the pressure is to be measured. Then, place the model in a wind tunnel, with the measuring instrument placed in one hole, and fill the other holes with some easily removable substance. With the model in the wind tunnel measure the pressure for each hole, first to windward and then to leeward. In every case the negative gage pressure, namely the suction effect in the lee of the sail, will be found to be from three to four times as much as the positive pressure on the windward surface. To obtain the total pressure or driving force at any point of the sail, the positive pressure on its windward side is added to the negative pressure on its leeward side. Thus, as the negative pressure is three times greater than the positive pressure, it may be readily seen that the "suck" is of primary importance. This has led the sail designer to new designs and more careful study of the lines of flow on either side of the sail.

Lines of flow, when plotted on a graphical picture of the sail, show many interesting peculiarities. Diagram No. 1 illustrates the lines of flow for a sail. To obtain such a diagram is fairly easy as no elaborate equipment is needed. Merely take a boat hook and to one end attach a fine piece of thread, to which has been fastened a small piece of down. Then grope around the sail and you may easily plot the lines of flow. The diagram below shows the lines of flow for the jib and mainsail of a gaff rigged boat. One is at once struck by the peculiarities of the wind, and, before much thought, there seems to be no logical explanation for the directions of many of the currents. Holding the down close under the boom (see region *a* of Diagram No. 1), and moving it slowly along that spar toward the mast, we notice the following: toward the after part of the sail the down flutters under the boom, almost aft, in extreme cases with a slight tendency toward the lee; *this divergence becomes more pronounced as we approach the mast;* the air current forms a constantly increasing angle with the boom, becoming nearly 90° at the mast. Then repeat the experiment under the jib and obtain the same result. Why should the air current on the imaginary boundary between the windward and leeward side of the sail tend more toward the perpendicular to the plane of the sail as we approach its luff (forward edge)?

The second peculiarity deals with the windward side of the main sail and the luff of both sails. The current is almost always directed forward in the fore quarter of the main sail, and aft (toward the stern) in its other three quarters (see region *b* of Diagram No. 1).

Now let us pass the down along and close to the leech, or after edge, of the jib and the mainsail (see regions *c* and *d* of Diagram No. 1). In the case of the jib the down is blown toward the lee, with a certain acceleration around the leech, and in the lee of the jib its direction is forward. But this is not the case with the mainsail. The down retains the direction it has along the sail, *i.e.,* it is blown directly aft. In order to obviate any possible influence of the jib on the mainsail, which indeed, one might easily suspect, since the wind is partly thrown off the jib onto the lee of the mainsail, the experiment is repeated without the jib; but no difference is apparent in the behavior of the current as it passes off the leech of the mainsail.

Next, investigate the currents along the mast with the down: on the windward side of the mainsail, just abaft the mast, a strong eddy is discovered which either carries the down forward toward the mast or causes it to fly in all directions. Directly next to the mast the down is driven forward around the mast toward the jib. Consequently, this current, which is directed forward, is utilized again by the jib.

These experiments not only make all existing theories more or less contradictory, but also set up many questions, difficult to answer. Below are the explanations that have been worked out from several detailed studies.

1. Immediately under the boom, the down is blown toward the lee at a larger angle to the boom increasing as the mast is approached. This is caused by an increase in the suction, the maximum negative pressure lying just abaft the mast.

2. The best proof of the intensity of the suction is the great velocity with which the down is sucked through the narrow slit between the mainsail and mast. The acceleration of the air current that pulls the down toward the lee is thus confirmed and the same phenomenon can be observed on the luff of the jib.

3. That on the leech of the jib the down is sucked strongly toward the lee and even blown forward on the leeward side of sail is accounted for by the large suction, which is active on the leech of the jib. On the other hand, the fact that the down is blown directly aft along the leech of the mainsail is explained by the weak development of the suction in that region.

Diagrams 2 and 3 show the pressure areas on a sail. These areas were determined by means of the same experiment in which it was found that the negative pressure was greater than the positive pressure.

Let us state briefly, here, the physical laws by which the action of the wind on a plane surface is governed, and upon which the flight of man on sea and in the air partly depends:

1. The requisite air pressure or density, which renders it possible for the bird or airplane to float or soar freely in the air, is not obtained until the wing is struck by air that has attained a certain high speed. This speed, enough to float the bird or plane, can be attained in two ways. Either the plane moves against the air or the air moves against the plane. To the former category belong gliding flight as, for instance, the gliding of a bird from the crown of a tree to the ground, whereby height, which is essential here, is sacrificed; and also the ascent of an airplane, the speed of which is increased by the propeller until it is borne up by its planes, whereby no initial height has been sacrificed. To the second category belongs the bird or glider sailing or soaring against the wind.

2. For flat surfaces the pressure or resistance increases as the square of the velocity and directly as the area of the surface, according to the formula:

$$A=0.13FV^2 \sin a;$$

Where A is the pressure on the surface; F is the area of the surface; V is the velocity of the surface relative to the air, and a is the angle between the surface and its direction of motion.

A second favorable factor for flight is that the wind has not, as is commonly supposed, an exactly horizontal direction, but blows at an angle of about 4° upward.

Diagram No. 2
Positive Pressures (Windward Side)

Diagram No. 3
Negative Pressures (Leeward Side)

Diagram No. 4
Wind Forces On Arched And Flat Surfaces

At once, after reading these laws, one is struck by the number of times the bird wing is used as an example. Therefore, it might be wise to investigate the bird wing closely, and to see if we can learn anything from it. First, as we consider the different birds, we realize that the longer the wing, the better soarer is the bird. To the albatross, for example, nature has given remarkably long, narrow wings—up to a span of nearly ten feet—which, in spite of their comparatively small area, as compared to the area of the wings of other birds, bear a comparatively large body, often without any movement of the wings and on the lightest breeze.

Next we see that all wings have a certain degree of arching; this should surely demand further consideration and careful study. Diagram No. 4 shows the forces which act on arched and plane surfaces.

The parallelogram of forces for the arched surface will be a surprise to the layman. On the plane surface held in a horizontal position appears a force K acting in the direction of the wind, which tends to move the plane in that direction. It is the resultant or sum of two retarding or obstructive forces, that act in one and the same direction. On the other hand, for the arched surface the resultant force R is directed upward with a tendency against the wind. The advantage of arching becomes more pronounced, when the wind strikes the plane at an angle from below or when the plane is moved against the wind in an inclined position. The arched surface develops more than double the force of the plane surface in this position.

Evidently, from the discussion above, careful study of the shape of the sail is necessary. First, the models of different sails were tested under the same conditions and those that had rounded ends were in every case found to perform better than those with sharp corners or ends. With reference to our sails, we may, in view of this, establish the following principles:

1. The Bermuda rig is one with the luff of the sail either slightly and uniformly curved from top to bottom or (what is better and more practical, on account of the simpler method of staying the mast) run straight up from the deck for at least two-thirds of its length and then bent back gradually more and more toward the top.
2. For the Marconi sail, a perfectly straight mast from top to bottom is, however, in spite of the theoretical advantages of the curved mast, preferable on account of the difficulties encountered in staying it properly; but pronounced inclination aft or so called "rake" of the mast should be avoided.

Next we should investigate the relation of length to breadth. Here again we use the models but this time in a reservoir with ink in the water and sawdust on its surface. The following facts were obtained.

1. The high sail, in consequence of its better qualities to windward, where it develops about a third greater pressure than the low (gaff) sail, is superior.
2. The proportion of height to breadth should be at least 3:1.
3. With the wind abeam the ordinary gaff sail is more difficult to handle, but if properly tended it develops about a third more pressure than

Marconi-rigged Racing Sloop

the Marconi sail does.

4. The gaff sail has to be hauled in about 15° closer than the high sail with the wind abeam.
5. In consideration of the direction of the forces acting on the sail, a gaff sail should be carried at an angle of opposition of about 35° with the wind abeam, the high sail at about 20°.
6. Before the wind the gaff rigged boat should, in most cases, sail a somewhat zigzag course, whereas the Marconi rigged boat should seldom deviate from the direct course.

Lastly, we consider the arching. One is confronted with the following questions: Shall a sail be arched? If so, how deep, and where, should the greatest arching be? There is no doubt as to the answer to the first question, since for the last seventy years yachtsmen have been using an arch in their sails and have obtained very satisfactory results. All experiments which have been performed show that arched sails have a strong superiority.

The next question, "How deep should the arch be?" is not so easily answered, and until very recently no definite information on this subject had been obtained. Now it is known that the lighter the wind the greater the arch should be. However, the great expense of having a boom made so that the arch can be adjusted at will leads us to consider what single arch will be best under all conditions. From the experiments performed it was found that an arch of 1/7 was the best for all conditions, and, as for the last question, it was found at the same time that the largest arching should be in the sails fore third, and that a uniform arching gave results that were hardly less favorable.

From this short discussion of the experiments performed on sails and their results, it is evident that some progress has been made in the design of sails but that there is still much experimental work to be done. Progress has been slow and will continue to be slow for many reasons. Today there are relatively few people interested in sailing, and but few big companies with sufficient means to carry on extensive experiments. These companies (boat building concerns) are handicapped, as the types of boats they are called on to build are unlimited. Yachtsmen do some experimenting of their own but the results are slow to leak out, as today most of them are interested in racing and therefore keep the results of their work for their own advantage. For these reasons and others sails and sailing have changed but little through the ages but it is to be hoped that now that the study of aerodynamics has become universal and popular, greater strides will be made in sailing—one of the first means of transport that the world knew.

Schooner Under Full Sail

EDITOR'S NOTE: Sailboat racing has become a popular sport here at Cornell, under the surveillance of the Cornell Corinthian Yacht Club. During the past few years, Cornell yachting crews have entered into competition with crews from several of the Eastern colleges, and last year won the Eastern Intercollegiate Championship. At the present time the headquarters of the Club are in the old Cascadilla Boathouse, but plans are being made for the construction of a new boat- and club-house on the Cayuga Inlet. Other plans for the future include the acquisition of sixteen Frostbite dinghies, a power launch to accompany the fleet, and a standing fund to provide for insurance and maintenance costs. The Club holds boat races on Cayuga Lake every week end, weather conditions permitting.

Because of the great interest shown along these lines, Professor Boothroyd, head of the astronomy department in the School of Civil Engineering, and formerly instructor of navigation at Annapolis, offers a course in nautical astronomy and navigation. University credit is given to those students successfully completing the course. Nick Bissel, Commodore of the Cornell Corinthian Yacht Club, gives a course in racing tactics.

German Technical Education

By John Hedberg, C.E. '29

Suppose that the United States Government, in fear of foreign invasions, should decree that every able-bodied boy, upon reaching the age of nineteen, should be taken immediately into the army for a two-year training course and upon release should then spend another six months at hard labor on idle agricultural lands. Suppose some of the boys, in pursuit of an engineering education, had reached the end of their freshman year in college and had just finished the fundamentals of mathematics, physics, and chemistry. How many of them would feel inclined to return to their studies after the two and a half years? How much of their fundamental studies would they remember, and how old would they probably be when they obtained their degrees?

Questions like these are actually being faced in Germany today, although they are greatly overshadowed by the more serious question of how long it will be before another war will break out. Already, however, the ten technical universities in Germany have suffered the cut in enrollment incidental to the military impressment of their prospective students. But it is too early to observe the effects of army life and loss of time on these young men. One can only speculate about them, and that speculation is anything but encouraging.

Germany has been a leader in technical education almost from its beginning. Its technical schools had an early origin and have continued their growth and development to reach world recognition. Our American institutions—Cornell in particular—have learned much from German practice. The precision calculations of engineering have always appealed to the methodical genius of the German mind.

In view of these things, it is not surprising that German technical education should be somewhat more difficult and a more serious undertaking than our American brand. A student must acquire a preliminary education equivalent to that reached by the end of the freshman year of our American college before he enters the technical university in Germany. That means that he is expected to know his analytics and calculus, his physics, chemistry, and languages. In addition, the German technical colleges require six months to a year of practical experience before the student matriculates.

The engineering program of study is nominally eight semesters, or four years, but the work is so arduous that most students require another semester or two before qualifying for the degree of "Diploma Engineer." It is undoubtedly true that part of the difficulty lies in the fact that the professors treat their students as mature men and expect them to acquire their knowledge from the lectures without the prodding so prevalent in our American institutions. Another difficulty in the German course is the infrequency of examinations and the necessity for the student to have more material in mind when the time for quizzing finally arrives. By the time the student obtains his degree, he is expected to know all the material of the entire four years, instead of having forgotten his freshman work by the end of his sophomore year.

All in all, the German technical eucation is a strenuous affair, even when uninterrupted. Graduation into the engineering profession and the acquisition of independence are necessarily at somewhat greater ages than in America. Twenty-five is perhaps a good average age at which the student obtains an engineering diploma in Germany. Additional time is required, of course, for those who acquire the title of doctor.

Consider now the requirement of two and a half years of military and social service. Obviously it is not just a matter of adding this time to the age of each prospective diploma engineer. Too many other factors enter and prevent its being as simple as all that. Even for those who return to their studies, at least an additional half year is needed to review the material forgotten. The difficulty of forcing oneself to such review and the accompanying doubts as to whether one can get back into the old routine after a long lay-off are bound to turn many prospective engineers into easier paths. The military profession would probably be the line of least resistance.

Another factor, which always confounds those who would lengthen our educational course, is the cost. Until the student obtains his degree and finds a job, it is likely that he is a financial burden to someone. Obligation to one's family is a mighty important consideration to any young man, regardless of nationality. Under this same argument comes that powerful corollary, the urge to marry. Usually education requires the postponement of marriage. The longer the postponement, the more difficult becomes its continuance.

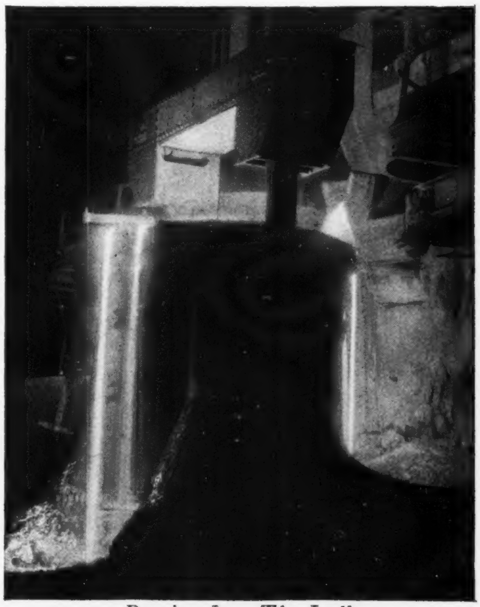
Whichever way one looks at it, these military measures will hurt German technical education. If standards were lowered, the same number of graduates could be maintained; but without lowering the standards, it seems inevitable that there must be a decrease. If this meant bettering the quality of the graduates, as it probably would if it were only a matter of increasing standards, a compensation would result. In the actual situation, however, the number that graduates is bound to contain a larger percentage of individuals who are fortunate enough to have some disability which will keep them out of the army and the social service. That these may not represent the best material for engineering practice is all too apparent.

Military programs are always so costly to a nation in material ways that other losses entailed by them are often overlooked. Among these should be recognized the impoverishment of the engineering profession in a country that has long been a leader.

EDITOR'S NOTE: John Hedberg, the author of "Technical Education in Germany," graduated as a Civil Engineer from Cornell in 1929, received the degree of Master of Science at Purdue in 1931, and his Ph.D. at the California Institute of Technology. At present, he is a professor in the department of Civil Engineering at Stanford University. Mr. Hedberg obtained information for his article while travelling in Europe this year as a member of the Freeman Fund. This fund was established in 1924, by the late John R. Freeman, Past President and Honorary Member of the ASCE. The purpose of the Freeman Fund is to aid and encourage young engineers in hydraulic research; to underwrite the cost of translating papers on various phases of hydraulics; and to provide funds for travelling scholars.

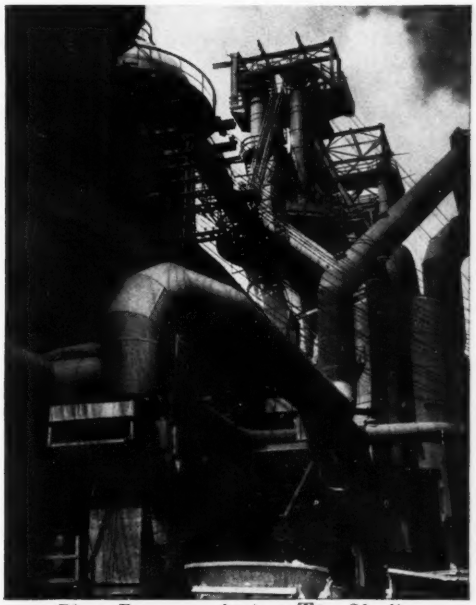
STEEL -- A Modern Industrial Giant

By A. H. Sullivan, E.E. '38



Pouring Into The Ladle

Steel Photos Courtesy of Bethlehem Steel Co.



Blast Furnaces Against The Sky-line

Steel is an industry. It counts its costs and profits in dollars and cents even as the hardware merchant, the grain-dealer, or the broker. It has its labor problems and its stock-holders' reports. But orderly rows of figures can never tell the whole story of steel. Back of steel production is the story of heat—backbreaking work—engineering development—the romance of one of America's biggest industries—the story of a modern industrial giant.

The enormous steel production of today has risen from a tiny start during the Civil War period to the present annual production of an estimated one-third ton per person in this country. The great increase in steel production can be realized only when it is seen that an advance of over 3,000 per cent in per capita consumption occurred between 1860 and 1900, and a further increase of 300 per cent occurred during the first quarter of the present century. The development of less expensive steel processes led to an increase in railroad building and bridge construction and set loose the economic forces which have created the modern industrial era. Without steel we would have no automobiles, no trains, no skyscrapers, no modern ships, and no airplanes. The low price has allowed the advance of electrical machinery and has thus given impetus to electrical design and construction, which has changed our manner of living.

The adaptability of steel is almost unlimited. It is still the strongest of the low cost metals, and is easily fabricated. The invention and development of the continuous strip mill and the progress in alloy composition has increased the field of steel application enormously.

Whatever it is—steel construction beams, rails, screening, machine tool castings, kitchen knives, bendable piping, screws, rivets, armor plate, transmission towers, or engine blocks—there is some type of steel for the job. Alloy steels have made possible the use of metal for purposes which formerly either required special composition materials, or presented problems which had no low-cost solution.

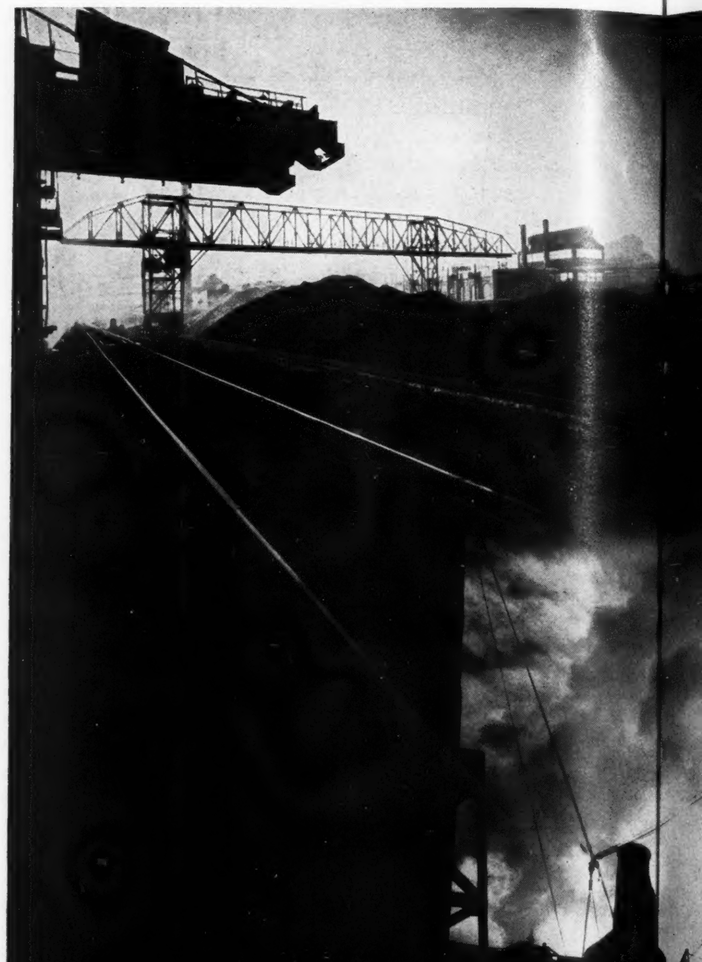
Until 1860, production of steel was possible only after great expenditure of time and money; and then the quantity produced was hardly enough to be of any practical value. With the introduction of Bessemer's process, steel production took on a new meaning. His air-blast idea made it possible to produce steel in such quantities that full use could be made of its remarkable characteristics in railroad and construction work. With the introduction of the open-hearth, steel production again jumped to a new high because more varied types of ore, pig-iron, and scrap could all be used in the new furnace.

In recent years new and different processes have been evolved to make it possible to use steel in an almost unlimited number of ways. The metallurgist has advanced his knowledge to the point where he can predict precisely the effect of adding small amounts of alloying elements to produce a steel of practically any composition and characteristics, and, what is more, he can create processes by which this composition can be produced in practice.

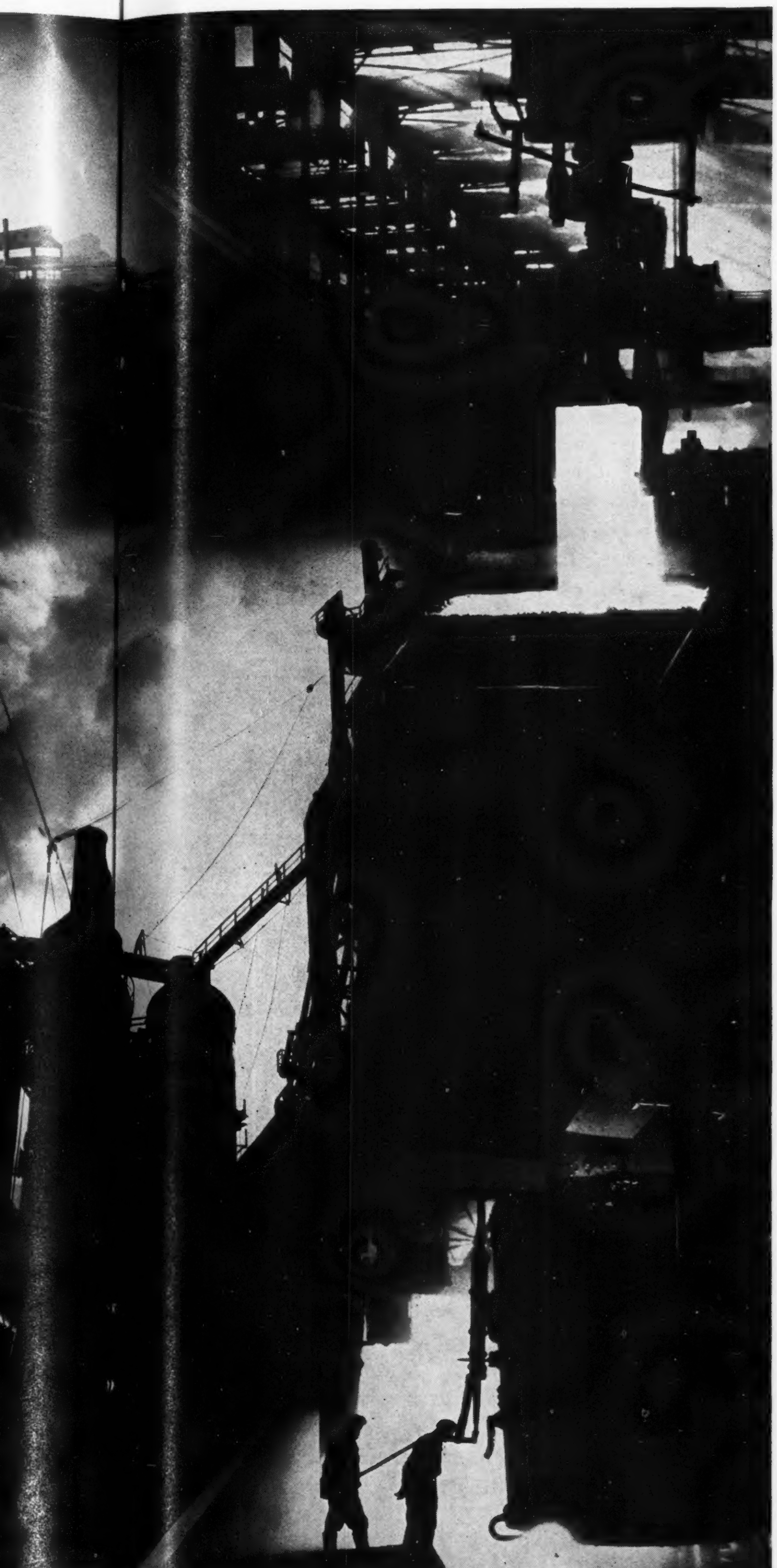
In the past, irons and steels were made directly from the ores, in one process. With the advent of the blast furnace, an intermediate step was established — the making of pig iron. Present day steel is all made from blast furnace pigs. The blast furnace is charged with alternate layers of iron ore, fuel and flux. The fuel, generally coke, not only supplies heat to the material in the furnace, but acts as a reducing agent. It is imperative that the fuel have a very low sulpher content. Limestone is generally used as a flux. The reactions in the blast furnace take place under the influence of a blast of hot air at a pressure of about 25 pounds per square inch. Operation is continuous, and the resulting iron is tapped off about every six hours, while the slag is removed at four hour intervals. The slag which is formed is definitely not a waste product —it is used in the manufacture of Portland cement and finds considerable use as a ballast material for railroad tracks. The gases, too, are used in the plant for preheating the blast air.

Most of the pig iron is ultimately transformed into steel in the Bessemer Converter or open hearth furnace.

In the Bessemer process, the converter is filled with molten pig iron and a hot blast of air is blown through the charge through tuyeres at the bottom of the converter. This air causes oxidation of the impurities in the iron, and also removes most of the carbon. The



Photomontage of Ste



Photomontage of Steel Process

composition of the steel is controlled by shutting off the air blast when the carbon content has been reduced to the desired amount, as indicated by the color of the flame at the mouth of the converter. Another method of control is to burn out practically all of the carbon and then to add the necessary amounts of carbon, silicon, manganese, and other metalloids before the converter is poured.

If the steel is to be made by the open hearth process, a charge of pig iron and steel scrap is placed on the hearth of the furnace. Heat is directed onto the hearth by a refractory roof. Due to the heat, silicon, manganese, and phosphorous are oxidized out as a slag, and the carbon is burned to carbon dioxide.

From the Bessemer converter or the open hearth process, the steel is either cast directly into sand molds for making steel castings, or it is cast into large metal ingot molds. The ingot molds are lifted as soon as the outside layer of steel is sufficiently hard to support the still molten core. At this point the ingots are transferred by crane to a soaking pit where the temperature is maintained at about 1200 degrees Centigrade. The ingots remain there for a long time so that the carbon will diffuse, and the composition become homogeneous. From the soaking pit the ingots are taken to the rough rolls, where they are rolled to their approximate final shape, as they are cooling. At around 750 degrees the ingots go through the finishing rolls, and after this operation they are allowed to cool to room temperature. Subsequent treatments may be cold rolling, extruding, spinning, drawing, hammering, forging, or any of a number of heat treatments. Modern methods of mechanical working of steel have evolved from the hand-forging and hammering, of the ancient smiths, in producing a sword or spear, to the modern drop-forges, power hammers, presses and rolling mills which are used in the so-called continuous processes. To these pieces of apparatus the automobile industry owes its existence. Stamps and dies have made it possible to produce modern products at the low price to which we have become accustomed. Rolling mills have made possible continuous production of structural forms and sheeting for industrial processes.

Behind the progress of steel is the overtone of giant plants—smoke-filled skies—towering blast furnaces at tapping time, with the colorful display of great sparks as the roaring iron is poured into the sanded channels of the pigs—the red fire of the coke as it is pushed from the narrow oven to collapse, incandescent, into the car below—the hundred and fifty ton ladle, slag dripping from its sides as the grab claws of the crane speed it to its place over the long row of ingot molds—the operator of the charging machine standing among the crackling sparks of the circuit-breakers—the ingot, as it passes red and spitting through the blooming mills . . . . *steel!*

EDITORIALS

CULTURE AND THE ENGINEER

Much is said and written concerning the engineer's limited background. Critics of present engineering curriculums have gone so far as to say that the engineer, due to his lack of cultural background, must forever remain in ignorance of the finer things of life. Engineering students, hearing and reading these remarks, have realized that, to a certain extent, they are justified, and thus regular recommendations are made to faculty members at most engineering schools for the inclusion of a greater number of the so-called cultural subjects.

The criticism of this phase of engineering activity is no doubt deserved. There is, unfortunately, little time during a four year engineering course for the installation of this vaporous culture in the engineer's mind. However, (and critics should realize the fairness of this statement), it is seldom if ever that a non-engineering student manages to obtain and put into practice engineering skill and principles. He cannot design and build a road, a railway, a transmission line, a boat or any but simple buildings. He cannot design or operate a communications system consisting of telephone, telegraph or radio. He would find it impossible to provide an adequate drainage system, a city transportation system or an electrical generating and distribution system. Thus, curiously enough, without the engineer, we would have no great cities, no twelve-hour travel from coast to coast, and no well-illuminated, warm rooms equipped with typewriters and low-priced paper where the critic could expound his scathing denunciation of engineering education.

The engineer has much to be proud of in his education. His knowledge ante-dates that of his critics by a few thousand years. When the first engineer designed and constructed the first boat, the splitting wedge, the sail and the roller, he was demonstrating to the world that he was a doer and not a dreamer. Since that time his knowledge has been increased and enlarged upon until at the present time the engineer and his activities are of such a fundamental importance that if they were to suddenly cease to exist, the nations of the world and their governments and economic systems would be virtually paralyzed. Without the engineer, civilization would collapse, and then there might be a general realization of the importance of an Engineering Background.

THE PROBLEM PROBLEM

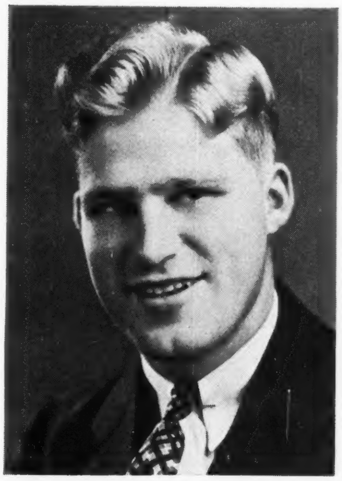
The solution of concrete problems is one of the most efficient methods of studying the type of work that we in the Engineering School encounter. To comprehend our work, it is necessary that we actually solve a number of problems of every general type with which we are likely to deal. We might think that this is an obvious and unnecessary statement, but how many home problems do we actually attack of our own accord? Not very many.

There are, in general, two ways of presenting home work to the students. Either the instructor points out definite examples and requires that a written solution be handed him at a subsequent time, or he suggests work, leaving it entirely to the student's initiative.

Concerning the first of these methods there is little alternative for the student. He must do the work, or receive a grade of zero for it. But in this case, there is some tendency to copy someone else's solution, or to receive help with it. The work, then, is not the student's own, and he has benefitted little or none by having "done" it. Recognizing this tendency, instructors are prone to give homework very little weight. The student owes it to himself to do his own work, when problems must be handed in as this is the way that he will obtain the most benefit.

The fault inherent in the assignment of optional problems is that often the student simply does not do the work. This is, in many cases, because the problems to be studied are not well defined. The assignment too often reads, "Problems at the end of the chapter." It may be argued that the ability to do all of the problems presented in a text are essential for a complete understanding of the subject, but the faculty does not really expect the student to do all of them. When such an assignment is given, the student throws up his hands in discouragement —he can not possibly find time to do all the work, so does none of it. The instructors can easily remove this evil by choosing each time, one or two problems that are representative of the entire assignment, and suggesting these to the student, instead of vaguely telling him to do all the problems concerned.

The solution appears to be in three parts; First—the student owes it to himself to do his own work; second—the faculty can assist by pointing out the most typical examples; third—it behooves the student to do all the optional problems, so assigned.



Lawrence Alfred Christensen

Do You Know These Men?

Franklin Smith Macomber

With experience in the engineering line already to his credit, and a highly successful course at Cornell in back of him, Lawrence Alfred Christensen, '37 CE, is now well prepared to tackle the hardships of life.

Coming from Boston, Massachusetts, Larry soon went away from home to find an education at Blair Academy, New Jersey, before entering Cornell. Since he has been in Ithaca, he has put particular stress on a general broadening of knowledge, and making friendships. His first extracurricular activity was in intramural sports, rowing on the C.E. crew, and from that start he is now a member of Tau Beta Pi, Phi Kappa Phi, Chi Epsilon, Red Key, President of Rod and Bob, and of the A.S.C.E., and last year worked on the Junior Prom Committee.

For several summers Larry worked in a shipyard in Boston, gaining much practical knowledge. His summer work has always been of an engineering nature—first as a machinist's helper, and later as an electrician's aid. Last summer he was employed in the Eastman Kodak concern, constructing a new building. His hobbies embrace mostly the field of athletics. He has always been an active participant in sport until two years ago when an accident forced him to assume the role of spectator. This appeals to Larry, however, and combined with hunting and fishing, affords him a good chance for relaxation.

In the future Larry sees much in store for him. His practical work has been to his liking and he is looking forward to more honest effort in his chosen profession. His college education has given him a wealth of knowledge, and little has been wasted through negligence. Finally, his contacts at Cornell have been varied, and he has made the most of his opportunities. He hopes to find work with a construction company away from home.

"From an engineering viewpoint the Leaning Tower of Pisa seems to be at present quite secure", observes Franklin Smith Macomber '37 AE, EE, in recounting his adventures on a recent trip through Europe with three other students.

Frank is a native of Toledo, Ohio, where he attended Scott High School. He later attended the Cranbrook School, where he was a member of the soccer and tennis teams and of the Glee Club. He was graduate Cum Laude in 1933.

His father a Cornellian, Frank had no doubts regarding his choice of a college. In his Freshman year he was a member of the Freshman tennis team. He has since been a member of the Freshman Advisory Committee, Manager of 150 pound crew, a member of the Crew Club, and of the A.S.M.E. He has the further individual distinctions of being President of Kappa Tau Chi, Treasurer of Sphinx Head, and Official Cataloger of Tau Beta Pi.

Beside the academic work accomplished at Cornell, Frank feels that contacts with Cornellians, past and present, as well as the training in getting along with other people, are invaluable gains After graduation he hopes to take a training course with one of the large industries engaged in production or engineering sales. He hopes to later become connected with one of the larger glass concerns in the middlewest.

Last summer Macomber and three other students made a tour of the principal countries of Europe. Their itinerary included a Faltboat trip down the Moselle to Coblenz, a bicycle trip through England, an exploration of the medieval walled cities of Würtzburgh, Rotenburgh, Dinkelbühl, and Nordlingen.

COLLEGE

COLLEGE RECRUITING

Judging from the interest employers seem to be showing in graduating engineers this year, the men in the class of 1937 will find the employment situation prior to graduation reminiscent of pre-1929. Last year was a considerable improvement over the year before, yet prior to midterm last year only four companies sent representatives to the campus while this year there have been eleven concerns represented to date.

Companies doing collge recruiting contact the seniors interested through Mr. J. R. Moynihan, who is assisted by Miss M. Komaromi. Short interviews are then held when a representative is on the campus in rooms provided in East Sibley. Files are maintained there on all the companies who do recruiting. These are open to all students interested.

During the spring term, the number of interviewers visiting will be considerably more than in the fall. Almost all of the companies who were here last year have arranged to return this spring, and in addition many who have not taken on men for the past few years will send representatives.

—O—

A.S.M.E. MEETING

At the last meeting of the Cornell branch of the American Society of Mechanical Engineers, former Dean Dexter S. Kimball lectured on the "World's Greatest Inventions." He discussed the effects of the important inventions on the lives of human beings all over the world, using slides to illustrate his talk. Dean Kimball is well able to speak on this subject. He was one of the four main speakers at the recent Washington Inventor's Convention.

The next meeting of the branch, to be held the last week of this month will consist of short papers presented by the members. The presentations will be in the form of a contest. The winner will represent Cornell among men from other schools where the papers will again be presented.

—O—

ON GETTING A JOB

On January 21, 1937 Mr. H. L. Davis conducted three sample job interviews before the members of the senior engineering class. These interviews are held every year as a part of the senior Non-resident Lecture course. Because of the interest shown in this particular demonstration in the past, it was held this time in one of the large Goldwyn Smith lecture rooms, where many beside engineers attended.

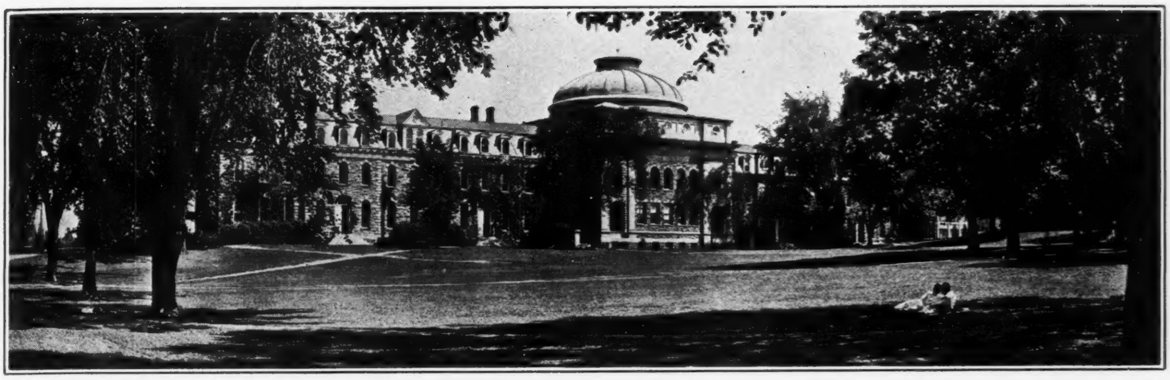
Mr. Davis, who is Director of Technical Training of the New York Bell Telephone Company, is also the author of "The Young Man in Business." Every year he contributes to the course in the form of two or three lectures, in which he stresses the importance of the applicant's preparation prior to an interview. He lays emphasis both on the necessity of the applicant knowing what he wants and what the company he is interviewing has to offer.

The demonstration was planned to simulate actual conditions as nearly as possible. None of the three applicants, one from each of the three engineering schools, had met Mr. Davis previously. Each in turn was interviewed in front of the remainder of the class and in conclusion Mr. Davis discussed his reactions to the approach of each applicant.

—O—

ARMY ENGINEERS

Each year the United States Army sends several of its West Point graduates to civilian institutions for the purpose of obtaining the most complete possible training in Civil Engineering. These men, members of the Engineering Corps, are selected from West Point gradu-



NOTES

ates within six years after graduation, and spend twelve months studying Civil Engineering at Cornell, M.I.T., Iowa, C.I.T., or Princeton. More than fifty graduate applications have been so approved. The West Pointers at Cornell this year are: First Lieutenants Ernest W. Carr, Maximiano S. Janairo, and Cyrus L. Peterson; and Second Lieutenants John D. Bristor, John B. Davenport, David H. Gregg. Henry I. Hille, and Charles B. Rynearson.

—o—

PHI KAPPA PHI

In a recent meeting, Phi Kappa Phi elected to membership the following men of the Colleges of Architecture and Engineering:

Architecture—L. A. Doughty and S. A. Shute.

Civil Engineering—L. A. Christensen and J. F. Stephens.

Electrical Engineering—R. W. Kunkle and D. M. Smith.

Mechanical Engineering—A. V. Mathey, F. F. Sampson, Jr., J. R. Ware, J. J. Serrell, Jr.

Elections are made in the senior year, in all schools and colleges of the university. Members are considered from the highest ranking eight of the class in scholarship. Of these, the five per cent having the most excellent character and personality is elected.

The members are eligible in their senior year for four fellowships offered by the national society, to give an opportunity for graduate work. The initiation and banquet for the newly elected members will probably take place in the latter part of January.

—o—

A. S. C. E.

At a joint meeting of the Ithaca section and the student chapter of the American Society of Civil Engineers on Monday, January 18, an illustrated talk on "Foundation Engineering" was given by Mr. Cummings of the Raymond Concrete Pile Company.

He explained the distribution of loads on soil, and how the loads are transmitted through the soil. He also showed various methods of making borings and explained the results that would be obtained. In addition Mr. Cummings showed interesting pictures of building settlement in Mexico City. Following the meeting refreshments were served and the meeting ended in the usual group discussions.

—o—

C. E. AWARDS

The School of Civil Engineering announces the following annual awards of medals and prizes effective during the current year:

GRADUATES

The Fuertes Medal.—For the most meritorious paper upon some engineering subject tending to advance the scientific or practical interests of the profession of the civil engineer, written by a graduate and submitted on or before April 15th. If in printed form, it must have been printed not earlier than the preceding April 15th.

UNDERGRADUATES

The Fuertes Medal.—To the student who, having attended the University for at least two years, has maintained the highest degree of scholarship for the period ending with the first term of his senior year.

The Charles Lee Crandall Prizes.—Four prizes for the most meritorious papers written by seniors or juniors on suitable subjects, provided both the substance and written form show real merit, submitted on or before May 1st.

The Robert Harris Simpson Prize.—To the senior who submits the best technical description or design of a civic improvement of sufficient substance and merit on or before December 15th.

CORNELL SOCIETY *of* ENGINEERS

J. D. TULLER '09, President

WALKER L. CISLER '22, Vice President — ADAM C. DAVIES, Jr. '15, Vice President

DAVID HARMON '31 Recording Secretary — JOHN P. SYME '26, Secretary and Treasurer

"The objects of this Society are to promote the Welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Column

February 4, 1937

Fellow Engineers:

Primarily this column, this month, is intended for the younger Cornell engineers—those who have been out of the University for, say, less than five years. Many of these men, it appears, and especially Civil Engineers, found employment during the depression as supervisors or in similar capacities in the C.C.C. or on W.P.A. projects or in other emergency governmental agencies. Inasmuch as these jobs were originally considered as stop gap engagements, the men registered with the Cornell Placement offices hoping to land other jobs when they became available. Recently there have been some opportunities for these men in private industry. Strangely enough some of the men have been reluctant or unwilling to give up the government jobs on account of the good pay that went with them or because they felt a greater sense of security in the government jobs. This appears to the writer of this column to be not a healthy or natural condition. Young men, and especially young engineers, should welcome opportunities for new experience and new adventures realizing that the money compensation is not the most important consideration. The early years after graduation, before the responsibilities of a family are on his shoulders, represent a real opportunity to a young man. During these years he can become acquainted with various kinds of work and various organizations. A varied experience will give him a background that will be valuable later. It will also help him to decide just where he can put his particular talents to work to the most advantage. At any rate we certainly would not advise any young engineer to cling to a safe birth in a temporary Federal organization just because the pay is somewhat more than he can get in a private job.

Now if any older Graduate has read this far and does not agree with the foregoing (or even if he does) we wish he would write us his views for publication in this column. We would be glad to have the younger men write us their ideas also. We would like to see some real live discussion in this column.

* * *

There is one aspect of the Cornell Placement offices that is worthy of mention. That is that these offices are in charge of Cornell men and are run for Cornell men. The Directors take a personal interest in the employment problems of Cornellians, and frequently discuss these problems with them at considerable length; not infrequently they advise a man to stay where he is rather than take a job offered if it appears that his best interest will be served in that way. They are always glad to talk with Cornell men regarding the employment situation.

* * *

We understand some young engineers in making application for employment to the Cornell Placement Bureaus ask for a *permanent* job. We are very much afraid there "ain't no sich animal." Even in commercial and industrial work changes are constantly going on and this is even more true of engineering work and especially civil engineering.

In a changing world it would seem that the young engineer would do well to prepare himself to make changes in employment. He will find it worth while to make numerous contacts and to develop a technique of looking for a job. Our whole social and business structure is now undergoing radical changes; adaptability and flexibility would seem to be very desirable characteristics for meeting the times that lie before us.

Sincerely yours,

J. D. Tuller
President

. . . WHEN HE WAS VERY YOUNG

As small boys, many fathers now living knew the telephone only as a little used curiosity. It grew into today's constantly used necessity largely because the Bell System never ceased looking for the new and better way. It stayed *young* in its thinking.

Young ideas developed "conference service", enabling several nearby or widely separated persons to talk on one telephone connection. Young ideas steadily made Long Distance service better, quicker, yet cheaper.

Young ideas are at work day and night to make sure America continues to get more and better service for its telephone dollar.

Why not call Mother or Dad tonight?
Rates to most points are lowest after 7 P. M.

BELL TELEPHONE SYSTEM

Alumni Notes

'88 ME—George W. Bissell married Martha F. Gere of Northamton, Mass., on September 14, 1935. He is retired and his address is Box 116, Monrovia, Calif.

'91 CE—John A. Knighton and Mrs. Knighton, of Bronxville, announce the marriage of their daughter, Marian Knighton, Christams day, to Julien H. Bryan, an alumnus of Princeton University. He is a traveler and lecturer on the Far East. Mrs. Bryan is a member of the faculty of Sarah Lawrence College in Bronxville. Knighton is chief engineer of the Department of Plant and Structures in New York City. Dr. Willis S. Knighton '18, a son, is practicing in New York City.

'04, '07 ME—James C. Rockwell is with the Manila Electric Company, Manila, P. I.

'06 ME—Joel D. Justin, consulting engineer, has moved his office to 1520 Locust Street in Philadelphia, Pa. He specializes in problems concerning dams and power.

'08 ME—Fayette A. Cook, of 15 Park Road, New York City, is associated with the Atlantic, Gulf, & Pacific Co. in hydraulic dredging. He has two daughters attending Cornell, Muriel, '38, and Elsie, '40.

'09 ME—Albert M. Lamberton, 626 Lenox Ave., Westfield, N. J., is a secretary and a director of the Mutual Building and Loan Association of Westfield, N. J.

'09 ME—John T. Johnson is President of Akron Pump & Supply, Inc. His address is 2324 Ridgewood Road, Akron, O.

'09 CE—William E. Piper resigned recently from the Dorr Co., Inc., to become assistant chief engineer of the Standard Lime & Stone Co., in Baltimore, Md.

'10 ME—Russell B. Hurlburt, European manager of the Pratt and Whitney division of the Niles-Bement-Pond Co., sailed July 22 for America to be at the works of the Pratt and Whitney Co., in Hartford, Conn., until he returned to Europe October first. His home address is 3, Square du Trocadero, Paris, France.

'10 CE—I. Elias Behrman, who was superintendent of construction and maintenance with L. Bamberger & Co., in Newark, N. J., became superintendent of Beth Israel Hospital, in Newark on January 1. The first person not a physician to hold that position, he has been on the board of directors since 1935.

'11 ME—Thomas Midgeley Jr., vice president of the Ethyl Gasoline Corporation, received the Perkin Medal for 1937 "for distinguished works in applied chemistry." His works resulted in "the creation of the entire ethyl gasoline industry with all it implies—use of higher compression engines and other advances" and his more recent development is a non-toxic, non inflamable refrigerant.

'12 ME—George J. Stockley has been elected president of the Village Officials Association of the Great Neck area.

'13, '16 ME—Harold W. Thorne, former president of the Holland Furnace Company and now a consultant for several large banks, has been elected assistant treasurer of the World's Fair to be held in New York City in 1939.

'14, '15 CE—Samuel Rosenweig is a real estate broker in Washington, D. C. He has two fine sons, the eldest is becoming a stage designer while the younger son has accomplished a great deal with the violin.

'18 ME, '19 MME—John W. Wieght, 9 Grace Court North, Great Neck, L. I., sends us a clipping from a Manila newspaper of June 15, 1936 announcing the appointment of Hermanegildo B. Reyes '18 as Dean of the Institute of Technology, newly added to the Far Eastern University in Manila to teach engineering.

'20, '21 EE—Alexander T. Grider's engagement to Beatrice Darsh of Westfield, N. J., has been announced recently. Miss Darsh attended Wheaton College. Grider is an engineer with the Western Electric Company. His mother, Mrs. Elizabeth C. Grider was for many years house director of the University residential halls.

'23 EE—Since 1930 Laurens A. Taylor has been employed in the aeronautics and marine department of the General Electric Co. in Schenectady, and is now assigned to special development and design. His address is 1369 Myron Street, Schenectady.

'24 ME—William M. Leonard is ass't. superintendent of the appliance maintainance division of the Consolidated Edison Co., of New York. He writes, "I have a husky 4-year-old daughter who will probably make the U. S. Olympic swimming team in 1948." His address is 789 Riverside Drive, New York City.

'24 CE—Harry W. Eustance, Ithaca's own City Engineer spoke at the annual joint meeting of the American Society of Municipal Engineers and the American Association of Public Works Officials in Toronto. He was one of two municipal engineers from New York State accorded a place in a symposium on public works problems.

'25, '26 CE—Mr. and Mrs. Bjorn R. Edstrom announced the birth of a daughter, Cisela, on October 24. Mr. Edstrom has been appointed vice-president of A. B. Svenska Aluminiumkompaniet, Stockholm, Sweden—Sweden's aluminum producing concern. His address is Valhallavagen 133, Stockholm, Sweden.

'27 CE—Mr. and Mrs. Walter B. Brandt (Olive Kinney '27) announced the birth of a daughter, Eleanor, on October 3, 1935. Their address is 213 Melburne Avenue, Syracuse.

'29 CE—Mr. and Mrs. J. Paul Blanchard (Edith G. Nash '30 BS) announced the birth of a son, John Fredericks. Their address is 58 Swift Street, Auburn.

'33 CE—Philip J. Krebs who is assistant manager of purchases at the University married Frances F. Palmer in Friendship.

(*Continued on page* 119)

Alumni Notes

(*Continued from page* 117)

'09 CE—Newton C. Farr, of Farr & Company, real estate, 140 South Dearborn, Chicago, Ill., is the new president of the Illinois chapter of the American Institute of Real Estate Appraisers. Farr is a former president of the Chicago Real Estate Board.

'11 ME—Francis C. Heywood is treasurer of Marvellum Co. and the Beveridge-Marvellum Co. "Both concerns are paper converters or coaters." He is president of the Glazed and Fancy Paper Manufacturers Association. Secretary of the Holyoke Veterans Association, he is past president of the Holyoke Lions Club. His address is 35 Amherst Street, Holyoke, Mass.

'12 ME—Carroll E. Carpenter is operating manager of National Automotive Fibres, Inc., and lives at The Whittier, Detroit, Michigan. His eldest son, Edward L. Carpenter, is a Sophomore in Administrative Engineering.

'13 ME—Sterling W. Mudge is assistant general manager of Socony Vacuum Oil Co., Inc., 230 Park Avenue, New York City. He lives at 11 The Place, Glen Cove, L. I.

'13 ME—William J. Russell has recently resigned as executive vice-president of the Queens Chamber of Commerce. He is now at work on the Thomas Edison Foundation campaign in California, Washington, Oregon, Idaho, Utah, and Nevada.

'16 ME—A. Stanley Ridgway is located in Washington. He is in the construction department of the Veterans' Administration where he plans the mechanical design for hospitals.

'18 ME—J. Ruhland Rebman, Jr. has been re-elected director for three years of the Philadelphia Orchestra Association.

'20 CE—Walter A. H. Grantz is director and assistant to the general manager of the F. C. Terminal Central de Buenos Aires and Subsidiaries, Corrientes 4002, Buenos Aires, Argentina. Last Spring he took a four month's vacation trip to the United States, visiting Ithaca for a short time in May.

'24 ME—Sylvan R. Hirsh is ass't. chief engineer of the Carbondale Machine Corp., Harrison, N. J., manufacturers of air conditioning and refrigeration equipment. He lives at 120 North Oraton Parkway, East Orange, N. J.

'24 ME—Joseph M. Bass, 49 Lehigh Ave., Newark, N. J., writes, "Since leaving the millwork business, I have been engaged during the past seven years in the fire adjusting business for the assured. My address is Federal Trust Building, Newark, N. J."

'25 CE—Bartlett Shapleigh is contracting engineer for the Bethlehem Steel Corp. His address is 146 Wentworth Ave., Cincinnati, Ohio.

STRESS and STRAIN

Father: Son, tomorrow is your twenty-first birthday. After that you're on your own, you know.

Son: "You're perfectly right, pop. Will you give me an automobile for a birthday present, so that I can shift for myself?

* * *

An instructor in the mechanics department was explaining a complicated vibration problem to the class. "In the case of critically damped vibration," said he, "the point never gets to the origin, but in aperiodic motion, it takes still longer to never get there."

* * *

The new superintendent called a hammer a hammer till he hit his finger with it.

—*Threads*

* * *

Colonel (instructing fliers)—"Now, what's the first thing you do upon making a landing?"

Pupil—"Thank God."

—*Threads*

* * *

The student organ of Allegheny College reports this flash of genius in a biology quiz. "When do the leaves begin to turn?" read the question. And this answer sparkled back, "At the same time as the midnight oil begins to burn, the night before exams."

—*Barometer*

* * *

Freshman (riding on one of Ithaca's fine roads for the first time)—"Gosh that was an awful bump; you must have gone off the road."

Upperclassman: "No, you have to be on the road to get one like that."

* * *

Have you heard of the fellow named Page?
Although he was tender in age,
He tried to enhance it
By using a transit
And looking through windows in Sage.

* * *

A customer, with proofs of his photograph. shouted at the photographer: "Do I look like this picture? Have I a squint, and do I look like a prizefighter? I ask you is this a good likeness?"

The photographer timidly replied: "The answer is in the negative."

* * *

One night a Pullman conductor saw a red lantern hanging on one of the lower berths, so he looked up the porter and said: Why is that red lantern hanging on that lower berth?

Porter: Well, boss, rule 13 in my book says that you should hang up a red lantern when the rear end of the sleeper is exposed.

* * *

Engineer's Whiskey Test

Connect 20,000 volts across a pint. If the current jumps it, the product is poor.

If the current causes a precipitation of lye, tin, arsenic, iron slag and alum, the whiskey is fair.

If the liquor chases the current back to the generator, you've got good whiskey.—*Rose Technic.*

* * *

Slight-of-Ham

A big buck Indian had just ordered a ham sandwhich at a drug counter and was peering between the slices of bread when he turned to the waiter and said:

"Ugh, you slice 'em ham?"

The waiter replied, "Yes, I sliced the ham."

"Ugh," grunted the Indian. "You damn near miss 'em."—*Nebraska Awgwan.*

* * *

The nurse entered Professor Zilch's room and said softly, "It's a boy, sir."

The professor looked up from his desk. "Well," he said, "what does he want?"—*Rose Technic.*

* * *

The little boy and his mother were walking down 5th avenue in New York

The little boy was looking at the skyscrapers. Turning to his mother, he said, "Mother, are there skyscrapers in heaven?"

His mother gravely replied, "No, son, engineers build skyscrapers."—*Rose Technic.*

* * *

Overheard in the mechanics department: . . . let us *azzume* a free body . . .

* * *

Two men were shooting, when the game warden popped up from nowhere and demanded to see their hunting licenses. Immediately one man darted off across the meadow like a hare. The startled warden gave chase, and after a mile or so of hard going, caught up with his quarry.

"Now," spluttered the protector of the law breathlessly—but before he could go further the runaway handed him a hunter's license, all in good order.

"Why the devil did you bolt," queried the warden, "when you had a license?"

"Well, it's this way," puffed the sportsman, "I have a license, but the other chap hasn't."

—*Kreolite News*